

MANPRINT PERSPECTIVES ON PERSONNEL TRANSFORMATION

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Introduction

Tomorrow's battlefield has been described as a complex environment, filled with new equipment and technologies. If our forces are to dominate in this environment, they will do so as a result of more than just having superior equipment. Real battlefield effectiveness is the product of a good match between the people who operate and maintain the equipment and the equipment itself. Army Chief of Staff GEN Eric K. Shinseki recognized this relationship when he wrote that the soldier remains the centerpiece of our formation.

At the heart of the Army vision are well-trained soldiers using state-of-the-art equipment to win wars. The Army's program to ensure that soldier issues are the critical drivers in system design, development, and acquisition is called MANPRINT (manpower and personnel integration; generally known as human systems integration or HSI throughout DOD). The objectives of MANPRINT are as follows:

- Optimize both the quantity and quality of the personnel needed for the system,
- Design training so that it is appropriate for the capabilities of the soldier and the conditions under

which the equipment will be operated and maintained, and

- Design systems that are easily used by soldiers, are safe to operate, cause no unnecessary health problems, and maximize soldier survivability.

MANPRINT is the process by which acceptable trade-offs are made among performance, design, and soldier issues. It includes the following seven domains:

- *Manpower.* Number of military and civilian personnel required and potentially available to operate, maintain, sustain, and provide training for systems.
- *Personnel Capabilities.* Required cognitive and physical capabilities of personnel to train, operate, maintain, and sustain materiel and information systems.
- *Training.* Instruction, education, on-the-job training, or unit training required to provide personnel and units with their essential job skills, knowledge, values, and attitudes.
- *Human Factors Engineering.* Integration of cognitive and physical characteristics into system definition, design, development, and evaluation to optimize human-machine performance.
- *System Safety.* Design and operating characteristics of a system

that minimize the human or machine errors or failures that cause accidents.

- *Health Hazards.* Design and operating characteristics of a system that create significant risks of bodily injury or death; threats include loud noise, chemical and biological substances, extreme temperatures, and radiation energy.

- *Soldier Survivability.* Characteristics of a system that can reduce fratricide, detectability, and probability of attack, as well as minimize system damage, personal injury, and cognitive and physical fatigue.

The MANPRINT process addresses trade-offs within and among these domains. For example, what are the implications within and across the domains of personnel capabilities, human factors engineering, and training with regard to increasing or decreasing the knowledge and skill demands associated with a particular operator or maintenance position? Optimizing the system from the perspective of a single domain is insufficient; one must consider the interactions and trade-offs among all of the domains. For example, in considering the design of a system interface involving high information rates and substantial complexity, one could take several approaches:

- Limit operators to soldiers having above-average knowledge, skills, and abilities;

- Develop and implement specialized training programs that support a wide range of soldiers;

- Use intelligent agents and other software processing techniques to place a greater burden on the system and reduce the workload of the soldier;

- Use some combination of the above.

The approach adopted would be based on trade-offs involving personnel availability, technical feasibility and complexity, development costs, operations and maintenance costs, maintenance implications, and other factors. The application of MANPRINT techniques not only results in more usable systems, but also improves the operational effectiveness of systems.

Strategic Value

The Army developed the MANPRINT process to promote the consideration of soldier issues at every stage of the system acquisition process. MANPRINT has been shown to be effective in improving system performance and in reducing overall life-cycle costs. For example, an analysis of MANPRINT issues in the development of the Comanche helicopter found that the application of MANPRINT would result in a projected cost avoidance of \$3.29 billion over the life cycle of the Comanche fleet. The savings will be the result of major design influences in most of the Comanche's systems. For instance, the design of the Comanche is optimized for easy maintenance. A portable, intelligent maintenance aid contributes to speedy fault identification and reduction in the rate of unnecessary parts replacement. Accessibility has been eased for most major components, and the engine maintenance tool set was reduced

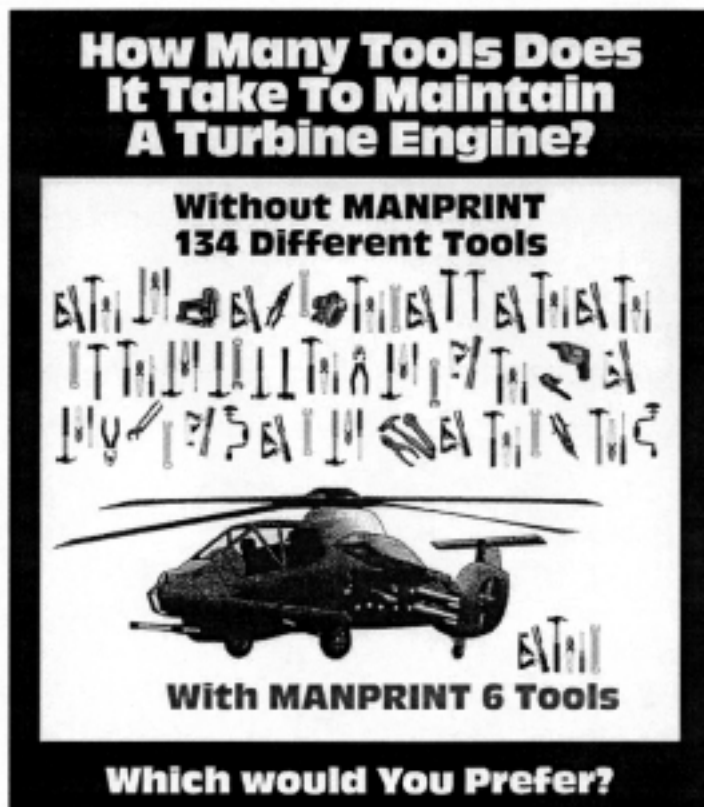
from the typical 100-plus tools to only 6. These design features and others reduce the number of maintenance personnel, reduce the cost of maintenance and parts, and greatly improve system availability, while also reducing the number of units required to accomplish missions. The Comanche Program was particularly significant in that MANPRINT principles were incorporated from the beginning, with MANPRINT issues receiving significant weight in the source selection process.

Task/Functional Analyses

The MANPRINT process employs task and functional analyses and modeling to optimize soldier efficiency in operating and maintaining systems. These analyses, matched with the relevant personnel attributes and well-planned training, can reduce the manpower requirements for a system or system-of-systems. Minimizing soldier risks in terms of health hazards, safety, and soldier survivability decreases the potential for unnecessary casualties, thus increasing readiness rates and reducing the total system manpower requirements.

Because early design decisions are so critical to life-cycle costs, MANPRINT must be employed early in a system's development cycle to maximize out-year operations and support savings. Failure to apply MANPRINT concepts to design can result in systems with inadequate performance, excessive manpower and personnel requirements, and significant health threats. (See "Why MANPRINT Makes Sense for Streamlined Acquisition," J. Hiller and T. Killion, *Army RD&A*, November-December 1995, Page 20.)

The heart of the MANPRINT process is its outreach to program managers and contractors. With the necessary education and appropriate tools and methods, program managers better understand the MANPRINT process and how it



contributes to reduced life-cycle costs, optimizes total system performance, and enables warfighters to win on the battlefield.

Army Transformation

The Army's transformation to the Objective Force is characterized by both materiel and personnel changes. New materiel systems, such as Future Combat Systems, must not only meet performance requirements, but must also meet standards of personnel affordability. If the future Army is characterized by systems that need too many operators and maintainers, with too highly specialized skills, where the training is too long and expensive, the Army will have failed in its transformation. It is the role of the MANPRINT Program to address such concerns throughout the design process.

The Army transformation's use of new, advanced technologies will require soldiers with new skills. The accelerated transformation schedule requires that tentative design decisions, made early in the acquisition cycle, be quickly and effectively evaluated by the MANPRINT community. Inadequate design decisions, made early in the acquisition cycle, can be compensated for later, such as through product improvements, but usually with significantly adverse consequences for the life-cycle costs of the system. Experience has shown that decisions made early in the life cycle of a system largely determine total life-cycle costs. To improve those decisions, project managers must be continually kept up-to-date on new information about MANPRINT and how they can be assured that their systems are compliant with MANPRINT guidance.

Personnel Transformation

To achieve the ambitious goals of the Objective Force, our personnel systems are also undergoing trans-

formation. The Army Deputy Chief of Staff, G-1, has initiated an effort to phase out "stovepiped," burdensome personnel management and support systems and replace them with an integrated, commercially based, multifunctional system. MANPRINT can and will play a role in these developments in two ways. First, just as it is applied to weapon systems, the MANPRINT process must be applied to information systems. The goal is to make such systems more usable, both for the operators and maintainers and for the customers (i.e., leaders and soldiers). Minimizing the personnel burden associated with operating and maintaining this integrated system can result in significant life-cycle resource savings. Providing more comprehensive, integrated information to decisionmakers will result in more effective and efficient personnel management. In addition, providing an interface to the soldier that is easy to understand and use and that requires minimum training, decreases access time, and increases quality of life. This is accomplished through faster access to critical information, more rapid resolution of problems, reduced frustration, etc.

Second, application of MANPRINT to the design of Objective Force systems will enable the Army to more effectively manage the personnel requirements associated with those systems. Informed design should allow us to develop systems that are optimized for future soldiers with regard to demographic characteristics, the knowledge and skills they bring to the situation, the training systems available, and so on. Synergistically, improved personnel management and effective system design will facilitate the realization of an Objective Force that has both the materiel and personnel to achieve dominance on the future battlefield.

Summary

MANPRINT puts the soldier at the center of the design process—equipping the soldier rather than manning the equipment. As the Army undergoes transformation to the Objective Force, it is as important as ever to apply thoughtful MANPRINT processes to the design of our future systems. This includes not only weapon systems, but also personnel management and support systems. MANPRINT, therefore, has a dual role in personnel transformation: minimizing the burden on future personnel through informed weapon system design, and aiding in the creation of personnel information systems with low overhead that effectively support both leaders and soldiers.

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